ON

DUMB-BELL CRYSTALS

OF

URIC ACID

DISCOVERED IN THE URINE.

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ON DUMB-BELL CRYSTALS OF URIC ACID DISCOVERED IN THE URINE.

The most remarkable and curious of all the formations which occur in urine is the dumb-bell, attention to which was first drawn by Dr. Golding Bird, by whom it was described as a condition peculiar to oxalate of lime. More recently, Dr. Hassall (see The Lancet, vol. i. 1850, p. 177) has pointed it out as a form assumed by other oxalates, and also by soda and potash, in combination with sulphuric acid.

Having been for some time past engaged in the analysis of urine, in a variety of diseases, I was led to make a series of experiments, for the purpose of determining the condition of the urine favourable to this formation; and in the course of these observations was enabled to ascertain the following interesting facts:—

Firstly. That dumb-bell crystals are very frequently developed, as the result of certain modifications of uric acid.

Secondly. That it is not to the salts of urine alone that this formation is confined, for I have frequently met with it in solutions which had no organic origin, and in a variety of salts.

I should perhaps premise, that although Nature seems to accomplish her ends without effort or excess, and sometimes most unexpectedly, it is occasionally very difficult, in prosecuting experiments, to arrive at satisfactory results. I am led, however, to the conclusion, that the form of the dumb-bell crystal depends upon a specific but independent force, deve-

loped under certain determinate circumstances, consentaneously with that of homogeneous attraction or aggregation.

I have observed, that when spicular crystals commence forming upon a centre, after stretching some little distance in a straight line, they begin to branch and spread outwards; and that as this lateral force is more or less vigorous, that of extension is arrested, and the tuft of spiculæ spreading from the central point, assumes the flattened globular shape, in a proportionately complete degree, and the same action taking place at both ends of the primary crystal, constitutes the dumb-bell form. It appears to me that this effect arises purely from the agency of electricity; and that, as an arranging power, it is quite separate and distinct from that of aggregation, and depends for its influence upon the repulsive force manifested towards each other by similarly electrified bodies.

The first effect of consolidation in the crystalline centre is the production of a small amount of electrical action, sufficient in itself to cause two especial points of that centre, when it is the basis of a future dumb-bell, to assume a mutual repulsion.

This compound formative power, being directed on two opposite points of the mass, will continue, until arrested by consolidation.

As the electrical or arranging force predominates, a limit will be fixed to the longitudinal extension of the crystals, and proportionately the lateral arrangement propagated, until a more or less complete dumb-bell is produced.

Occasionally this latter action is so powerful as to fill up with spiculæ and consolidate the entire space around the centre of crystallization.

But it is not my intention to enter into the very interesting subject of crystallization generally, many new phenomena of which, actual examination by the microscope has taught me, but to confine myself to the form and construction of the dumb-bells of uric acid. Uric acid and oxalate of lime

occur very frequently in the same deposit, and from their combined presence different forms of dumb-bell crystals are found together; it is therefore of the first importance to separate each salt carefully, before proceeding to subject it to experiment.

While analyzing some urine of high specific gravity, and in which there was a copious precipitate of uric acid, I added a solution of caustic potash in sufficient quantity to dissolve the deposit. The urine thus treated was twice filtered; a light flocculent cloud of uric acid, in combination with potash, made its appearance in a short time, and gradually subsided to the bottom of the vessel. The supernatant fluid being decanted off, hydrochloric acid, in great excess, was poured suddenly upon the sediment, which, after a rest of about a quarter of an hour, was found converted into a thin layer of opake dark-brown uric acid dumb-bells. These differed in the most marked degree from the dumb-bell of oxalic origin by their great insolubility in water. But the experiment is open to the doubt that an oxalate might have gained entrance.

I separated some highly crystallized uric acid from the urine in which it was deposited, and washed it thoroughly with large quantities of warm water; it was then dissolved in pure caustic potash, and filtered through paper. On adding strong hydrochloric acid in excess to this solution, dumb-bell crystals were deposited, some being of very perfect form, others not so.

Some pure lithic acid was dissolved in concentrated sulphuric acid; to this solution two-thirds of water were added, and there occurred an instantaneous precipitation of imperfect dumb-bells. To show the difficulties of this kind of demonstration, and the changes likely to result from varied circumstances, a small quantity of this concentrated sulphuric solution being dropped into a large bulk of water, the resulting deposit consisted of thin broad plates, the two edges of which, in the longitudinal direction of the spiculæ, were considerably thickened, forming ridges; but these plates, when rolled over

on their thin edges for examination, also presented a dumb-bell form, though from their narrowness it was impossible to retain them on the edge.

The dumb-bells to which I wish to call attention and give a description are those obtained in the deposit caused by the addition of hydrochloric acid to the potash solution. My reason for so doing is because I have observed the same forms as a natural deposit among uric acid; and these, although of such a remarkable form, have, I believe, until the present time, been left undescribed.

They consist of a thin translucent plate, of an oval or rhomboid form, having a slightly elevated ridge running along their middle in the direction of the long diameter, and from near the extremities of which extend two compact kidney-shaped crests of thin spicular crystals, their long diameter being across the plane of the translucent plate. A transverse section of one of the kidney-shaped crests would present an oval outline.

From the way in which the weight is arranged—namely, in the centre of the crests—the crystal has, while under the microscope, a tendency to float with the edge of the thin plate turned towards the eye of the observer. Circumstances, however, occasionally seem to dispose the face of the thin plate to be directed upwards, and then, without a close and careful examination by rolling the crystals over, their dumb-bell shapes might escape the eye of the microscopist, and seem to represent only rhomboid plates of uric acid.

In the hydrochloric deposit there was considerable variety of size, the following being measurements made with one of Powell's large microscopes:—

Long diameter of the largest crystals	...	...	$\frac{1}{650}$
Ditto ditto smallest	...	...	$\frac{1}{900}$
Long diameter of the largest crests	...	...	$\frac{1}{750}$
Short ditto ditto	...	...	$\frac{1}{1800}$
Long ditto smallest crests	...	...	$\frac{1}{1500}$
Short ditto ditto	...	...	$\frac{1}{2000}$

FIG. 1.

Represents the dumb-bell crystal as deposited by the addition of hydrochloric acid to the potash solution of uric acid.

a. The crystal with the edge of the thin plate turned towards the eye of the observer.

b. The same rolled over, to show the face of the thin plate.

c. Shape of a transverse section of a kidney-shaped crest.

FIG. 2.

The same shapes deposited from a concentrated sulphuric solution.

FIG. 3.

The forms assumed by the crystal when a small quantity of the sulphuric solution is dropped into a large quantity of water.

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